#### **ESSC**

## (Enterprise Systems Services Center) Project

# **Green Technology and Sustainability**

#### **Montana Digital Government Summit**

Mike Boyer – DoA/ITSD Project Lead August 25, 2008





## **Topics**

- ESSC design objectives/principles
- Challenges in power efficiency
- Ducted cabinetry
- "Free" cooling
- Cost/Benefit





## **ESSC Design Objectives/Principles**

#### Business Objectives

- Security
  - Safeguard the IT assets of the State against physical threats and cyber threats
- Continuity of government
  - Assure continuous processing of critical systems
- Improved services
  - Manage availability to meet customer requirements
- Efficiency of services
  - Make high quality IT operations available to all State organizations

#### LEED "Green" characteristics

- "Leadership in Energy and Environmental Design"
- Low impact building (air, water, energy, pollution)
- Power best practices to reduce demand
- Using LEED standards wherever budget allows
- Not pursuing certification





## **ESSC Design Objectives/Principles**

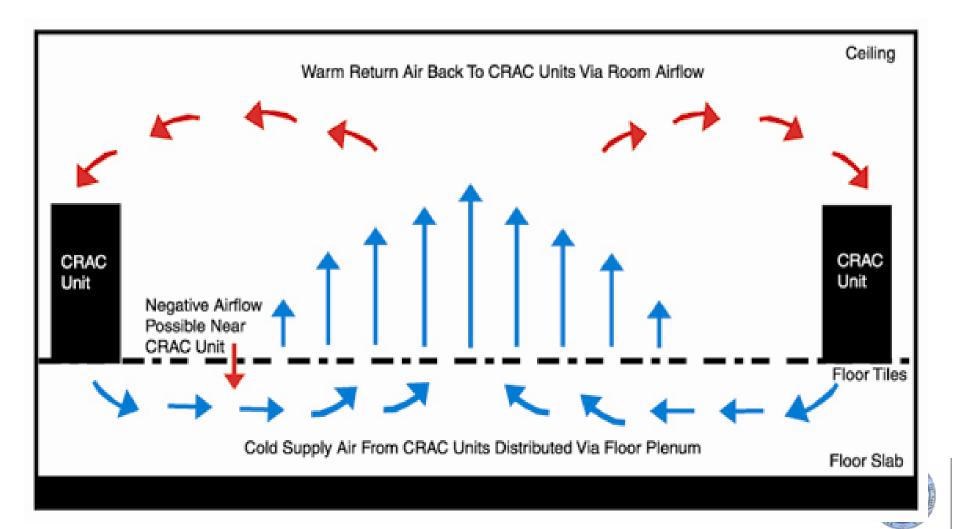
- Cooling efficiency
  - Heat recovery potential use of waste heat in adjacent building
  - Ambient air use
- Reduce power consumption
  - Reduce power draw of IT equipment
    - New equipment draws less and manages demand better
    - Expecting ~40% reduction
  - Reduce power required to cool the data center
    - Breakaway from conventional data center practices



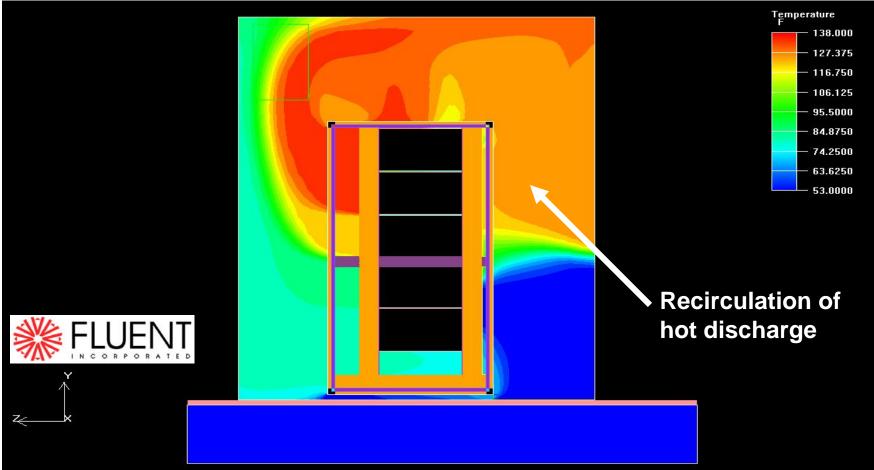




# Legacy Designs Cool air from raised floor



## Mixing Cold Supply & Hot Return Air







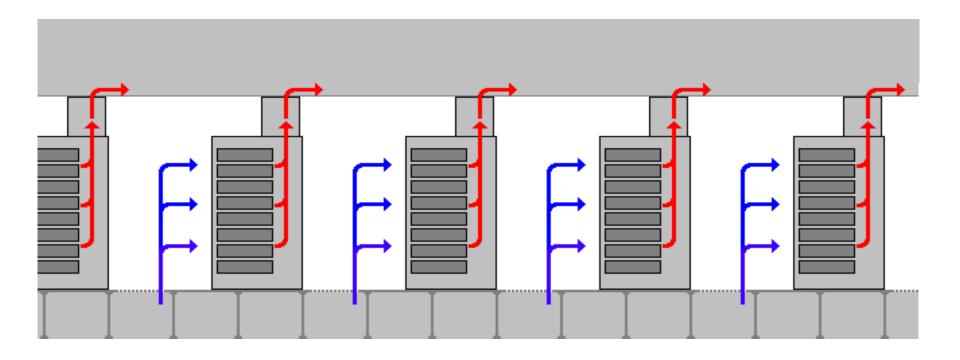
## **Eliminate Mixing**

- TOTAL Separation of cool air and hot return air
  - Sealed Cabinet Design or Sealed Rows
  - Treatment of the Cold Space as contiguous
  - Elimination of Zone Models and Tile Planning
- Circulated air passes only through IT hardware
  - Bypass airflow and recirculation is eliminated





## Stop the hot & cold air mixing



Cooling efficiencies and operational costs in data centers are significantly improved





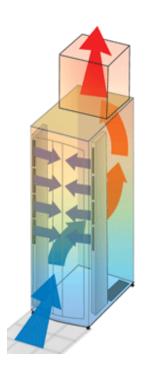
## **Emerging Energy Technologies**

#### "Passive Ducted

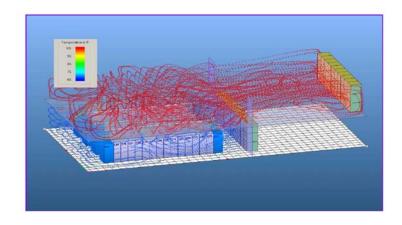
#### Cabinets"

How do we reduce the energy needed to cool the hot discharge?

- Enclosed cabinet isolates cold and hot air
- Accelerated cooling thru rack
- •Fluid dynamics-based; no power required!
- Significant reduction in cooling cost
  - Mfg claim 60+% increase in efficiency

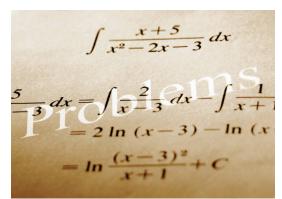


#### General Air Flow Pattern









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## The Challenge of Cooling

Power Usage Effectiveness (**PUE**)

PUE = <u>server power + cooling power</u>

#### server power

Typically ranges from 1.8 to 3.0 (surveys in the USA show an average PUE of 2.6)

- For every kW of server usage we are using between 0.8kW and 2kW of power to cool it
- New data centers with hot and cold aisles using raised floors would do well to get to a PUE of 1.8
  - At best, 44% of your power is for cooling!

Something different is needed!



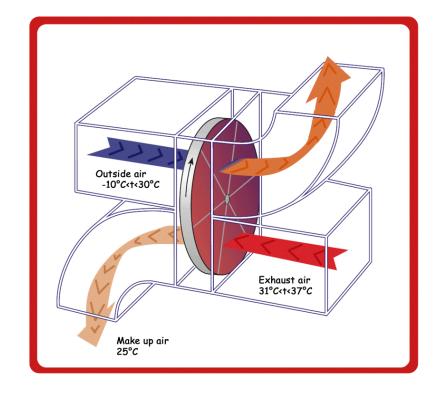


## Rotary Heat Exchanger

The rotor is constructed of an engineered lattice for optimal exchange which rotates between the hot exhaust air loop and the colder intake loop.

- Engineered Transfer Medium
- Microcrystalline Anti -Condensation
- Engineered Energy Transfer Controls
- Sealed 4 Quadrant Design
- Modeled efficiency

The rotor is warmed up in the stream of exhaust air and transfers the heat to the stream of incoming cold air.

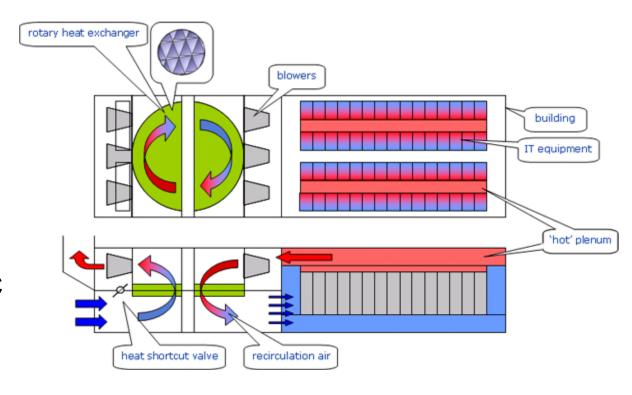






## **Kyoto Cooling Wheel**

- Integrated conventional CRAC cooling
- •Below ~74F degrees outside temps uses "free" cooling heat exchange wheel rather than CRACs
- Between ~74F and ~86F uses combination of CRAC & wheel
- •Over 86F run on CRAC only
- •12 foot wheel cools 300kW of servers (500kW of blades)







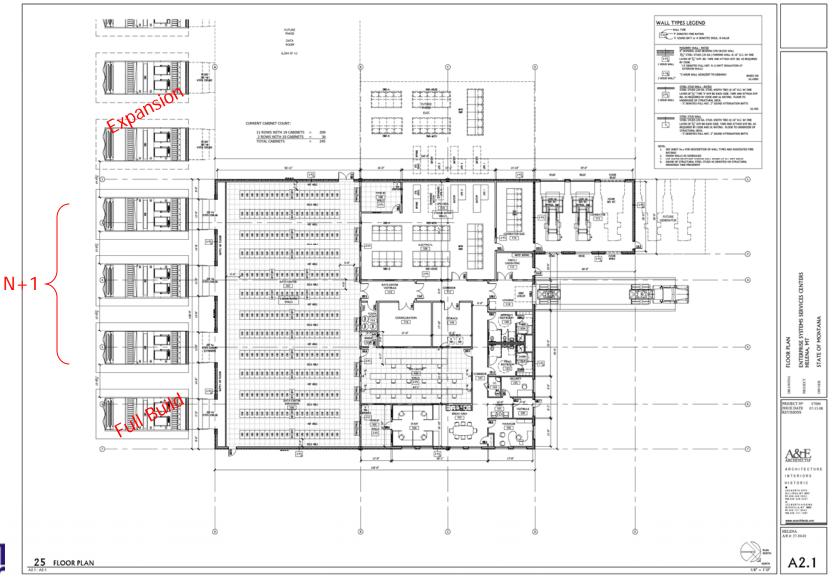
## In case you're curious ...







## Helena ESSC Floorplan





## What can we expect in Helena?

- Using 2007 as a basis
- 8760 Hourly Measurements



- 7514 Hours less than or equal to 22C (~74F)
  - 86% NO conventional cooling required
- 883 Hours Greater Than 22C Less than 30C (~86F)
  - 10% Partial benefit mix of wheel and conventional
- 363 Hours Greater than 30C
  - 4% Conventional CRAC cooling only





### Wheel Cost/Estimated Benefits

- Cost: \$500,000/wheel (installed plus site prep)
- Significant reduction in cooling power
  - TSS engineers conservative estimate: 1.7M kWh/year
  - Kyoto engineers more aggressive: ~ 4.0M kWh/year
- Payback of ~12.5-14 years (TSS conservative numbers)
  - Higher/safe PUE and \$0.068/kWh
- Payback of ~5 years (Kyoto aggressive numbers)
  - Lower PUE to give higher kWh savings
- •Miles City doesn't justify the investment due to very low electric rates and size of the facility
  - Using chiller with water-side free cooling.





#### This presentation and other ESSC materials available at: http://itsd.mt.gov/techmt/infrastructure.asp





